

ABSTRACT OF THE DISCLOSURE

An underwater torch with a metal infiltrated ceramic electrode for cutting and machining. The electrode has a composition with an empirical formula $MB_{2-z} + N$, wherein $0 < z < 0.10$ and M is selected from the group consisting of Zr, Hf and Ti, wherein N is selected from a group consisting of Cu, Au and Ag and wherein the MB_{2-z} defines a ceramic structure formed with ceramic and defining a volume with void spaces comprising at least 10 percent of the volume of the matrix structure and the N occupies a portion of the void spaces. A preferred electrode material is ceramic matrix of ZrB_2 slightly enriched in Zr that is infiltrated with copper. Preferred methods of making the composition involves at least two step: First, ZrB_2 (which preferably is slightly enriched in Zr) is formed into a ceramic matrix having a density of up to 96 percent. Second, the ceramic matrix is heated in a pool of copper at a vacuum and at an infiltration temperature of about 1700 degrees C. to permit copper from the pool to infiltrate the ceramic matrix. Preferred processes for making the product are similar to the processes described in the '574 patent. Applicants' tests have shown that conductors made for underwater electric discharge cutting provide good results. However, some significant erosion resulted from the flaking off of ceramic powders at the outer surface of the copper infiltrated electrodes when the surface copper melted during the cutting process. To minimize this problem, Applicants have modified the ceramics in the compositions described in the '547 patent. In a preferred embodiment, the metal content in the voids in the ceramic matrix is reduced from at least 70% to between 10% and 30%. In another preferred embodiment ceramic fibers are used in place of ceramic powders. In a third preferred embodiment ceramic wires such as ZrB_2 wires are utilized instead of the ZrB_2 powder. ZrB_2 wires are preferably prepared using a chemical process to convert the Zr wires to ZrB_2 wires. Bundles of the ZrB_2 wires may then be infiltrated with the copper.